years; and the whole source of confusion lies in the failure of those responsible for the British Association Reports of the time to insert the author's initials—the Allmans having been apparently referred to indifferently as merely "Professor" and "Dr."

While thus my precise statement concerning George James Allman's claim to distinction which is involved must be dissociated from his memory, perusal of his published writings still justifies us in regarding him as a scientific botanist of renown.

It has been pointed out to me that my reference to the late Beete-Jukes might be interpreted to mean that he was a professor in Trinity College, Dublin; and, in event of this possibility, I would remark that no such idea was intended. George James Allman was appointed professor of botany in Dublin University, in succession to William Allman, in 1844; resigning the appointment in 1856. Joseph Beete-Jukes became director of the Irish branch of the Geological Survey in 1850; and during the whole period of George Allman's occupancy of the Dublin botanical chair, the late Samuel Haughton was professor of geology. The allusion to the late Beete-Jukes was introduced into my notes by the kindness of a relative of the late George James Allman, and it is inaccurate as concerning the word "Professor," as I now find to be also the case with the word "Regius" as applied to the Dublin chair itself (which I owe to the obituary notice in the *Times* of November 28, 1898). "Professor" (line 19) and "Regius" (line 18) must accordingly be deleted from my article by those who would make further use of it; and I would remark that by "Grumera" (column 4), Gunnera is meant.

My best thanks are due to Mr. Britten, Mr. Griffith, and Prof. Percival Wright, for friendly assistance and advice in this interesting little bibliographic research, the limitations of which I appear to have by no means exhausted. G. B. HOWES.

Royal College of Science, London, S.W., January 9.

Since the above was written, we have received the following from Prof. Allman.—ED.

When writing the above I did not recollect that my father—many years later—read at the meeting of the British Association in Dublin (1835) a paper "On the Mathematical Relations of the Forms of the Cells of Plants" (Brit. Assoc. Rep. 1835, part ii. p. 79). This paper is erroneously attributed to Dr. George James Allman in the Catalogue of Scientific Papers of the Royal Society of London.—G. J. A.

January 16.

The Density of the Matter composing the Kathode Rays.

THE question of the size, charges and velocities of the carriers in the kathode rays has been made the subject of investigation by Prof. J. J. Thomson, Lenard, and others. I do not know whether it has been noticed that, by taking the values which have been obtained for the ratio of charge to mass, and for the velocity of the particles, in connection with the observed fact that a shaft of rays from a plane kathode retains its cylindrical form unaltered as it passes across the tube, we can arrive at a limiting value for the mass per unit volume of the matter composing the rays.

Take for simplicity a uniform circular shaft of charged particles travelling with velocity u. Let the mass per unit volume be m, the charge per unit volume e, the radius of the section a, and the velocity of light v. The shaft constitutes a current of strength $eu \cdot \pi a^2$. The magnetic force at the boundary is

$$H = \frac{4\pi \quad eu\pi a^2}{2\pi a} = 2\pi aeu.$$

If we take unit volume at the boundary, it will be subject to an electro-magnetic force, inwards,

$$= H \cdot eu = 2\pi ae^2u^2.$$

The same unit volume will be acted upon further by an electrostatic repulsion outwards of amount $2\pi ae^2v^2$ in electromagnetic units.

Hence the resultant force on it will be

$$2\pi ae^2(v^2 - u^2) \text{ outwards.}$$

Now if ρ be the radius of curvature of the outer boundary, we have

$$\frac{mu^2}{\rho} = 2\pi ae^2(v^2 - u^2),$$

or the curvature is

$$\frac{1}{\rho} = 2\pi a\left(\frac{e}{m}\right)^2 m\left(\frac{v^2}{u^2} - 1\right)$$

We know that this curvature is small.

Taking the numbers given by Lenard (*Wied. Ann.*, 65, p. 504), we may put, roughly,

$$\frac{e}{m} = 6 \times 10^6$$

$$\frac{v}{u} = 4$$

giving

$$\frac{1}{\rho} = 2\pi a \cdot 36 \cdot 15 \cdot 10^{12} \cdot m$$

$$= ma \times 3{\cdot}4 \times 10^{15}.$$

Therefore m must be smaller than order 10^{-15}, whereas the average density in the tube, that of air at the pressure of a fraction of a millimetre, is of the order 10^{-7}.

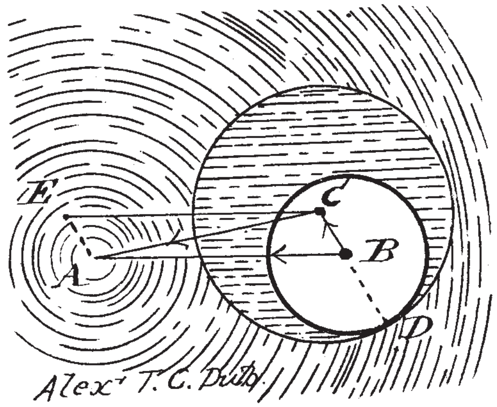
If we do not suppose that m and e are constant, but take them as functions of the distance from the axis of the shaft, we arrive at the above limit for the average density.

Queen's College, Belfast, January 9. W. B. MORTON.

Attraction in a Spherical Hollow.

AMONG the papers of the late Prof. Peter Alexander, of Anderson's Medical College, Glasgow, I find the enunciation of an interesting theorem in attraction. "The attraction on a particle of unit mass, in a spherical hollow in a sphere of uniform density, is at all points of the hollow parallel to the line joining the centres of the sphere and hollow, and is of constant magnitude equal to $\frac{4}{3}\pi c\sigma\kappa$. Where c is the distance between the centres, σ the density of the sphere and κ the attraction of unit mass on unit mass at unit distance."

I venture to give the following informal proof. Let A be the centre of sphere which may be supposed to be indefinitely great, and B a particle at the centre of the spherical hollow. Then the attraction on B is towards A, and is proportional to BA if the hollow be indefinitely small (see Dr. Tarleton's "Introduction to the Theory of Attraction," p. 13). But the removal of the spherical mass round B as centre in no way alters the attraction on the particle B. This proves the theorem for the central point. If the centre of the sphere were at C the attraction on B would then be BC in the same way. Let the particle be now placed at C any point in the hollow. Produce CB to meet the hollow sphere at D. If the spherical hollow be enlarged so that C is its centre and CD its radius, the force of attraction on C will now be CA. Restoring the mass to the space between the new and the original hollows, subjects the particle at C to an additional force, equal and opposite to BC. Hence the force exercised on the particle at C in the original hollow is CE, which is parallel and equal to BA.



This furnishes a good example of the theorems (*ibid.*, pp. 60 and 94), that if one or other the amount or direction of the attraction within unoccupied space be constant, then must both be so.

There is probably a formal rigid proof of his theorem among my brother's papers. He told me that some practical application might be made, by having the hollow just touching the

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surface of the solid sphere, at which point there might be a hole or door through which a small suspended magnet could be introduced into the interesting field of force.

THOS. ALEXANDER.

Engineering School, Trinity College, Dublin, January 2.

Fourier's Series.

PERMIT me to make a few remarks on the notes of Prof. Willard Gibbs and Mr. Love in NATURE of December 29, 1898.

Using Prof. Willard Gibbs's notation, write fx_n for the series

$$\sin x - \tfrac{1}{2}\sin 2x + \tfrac{1}{3}\sin 3x - \ . \ . \ . \ \pm \frac{1}{n}\sin nx,$$

and let C_n denote the curve whose equation is $y = 2fx_n$.

Consider the two curves C_n and C_{n+1}. Then it is easily seen that these curves intersect, when $x =$ any multiple of $\pi/n + 1$; and (omitting proof, so as not to cumber your pages with calculation, which is not difficult) it will be found that one of the curves passes through the extremities of the maximum ordinates of the other, and the other through those of the minimum ordinates of the first, in each case the curves cutting one another at an angle whose tangent is 2. Hence if d is the distance along the ordinate of one of these points of intersection from the slant part of the limiting broken line ($y = x$), on one of the curves the like distance will be less than d on one side of the point, and greater than d on the other side. The statement of Prof. W. Gibbs that, "if any small distance be first specified, a number n' may be then specified such that for every value of n greater than n' the distance of *any* point in C_n from the broken line, and of any point in the broken line from C_n, will be *less* than the specified distance d," is therefore incorrect. It is doubtless true that C_{n+1} is, as a whole, nearer to the broken line than C_n, but it is not true that every point in it is so.

The above, in fact, shows, for a particular case, what Mr. Love has remarked in more general terms in his note.

I cannot follow Mr. Love in his remark—if, as I suppose from his argument, it is intended to be general and not limited to the particular illustration—when he says "Thus, in the passage to the limit, every point near the vertical part of the broken line disappears from the graph, except the points on the axis of x."

May we not as legitimately reason thus? The maximum ordinate of C_n nearest to $x = \pi$ is that for which $x = n\pi/n + 1$. There is a point P corresponding to a value of x between $n\pi/n + 1$ and π, whose ordinate is any fixed fraction (the half, say) of the above maximum. If now n be increased without limit, P will in the limit coincide with the point $\left(\pi, \frac{\pi}{2}\right)$. Thus the vertical part of the broken line, in this way of arriving at the limit, *will* appear in the graph.

Would it not be more correct to say that, when n is infinite, the limiting curve has ordinates for the value $x = \pi$ indeterminate within the limits $-\pi$ and π?

R. B. HAYWARD.

Shanklin, Isle of Wight, January 5.

The Decrease of Swallows and Martins.

WHAT an age of contradictions this is! a statement is put forth one day by some one who has apparently every reason to be an authority, and it is contradicted the next day by some one else who also appears to have good ground to support his contradiction.

Whom are we to believe?

Before preparing the paper on the decrease of the Hirundinidæ, which I was privileged to read at the conference of the Society for the Protection of Birds, I sought for, and obtained a large amount of valuable information on the subject, and embodied the chief details in my paper.

The most useful contribution concerning the destruction of small birds, including swallows, in Italy, was from the pen of Mr. W. J. Stillman, who was, until recently, the *Times* correspondent in Rome, and who, in the course of a letter published in the *Times* of August 23, 1898, wrote:—"Swallows are *netted* by the thousand as they come to the shores of Italy in their northward migration, and are *eaten as food*. They are also caught in quantities in the most cruel manner with artificial flies and fish-hooks." [The italics are mine.]

Another correspondent wrote to me personally, telling of the wholesale slaughter of birds in the neighbourhood of Florence, and in other parts of Italy, and although he does not, in his letter, actually specify swallows and martins as amongst the slain, yet it is not unreasonable to conclude they were amongst the many small birds which he has seen daily in Florence, piled up four or five deep on flat barrows, some five feet by three, and he also says he had been told that the *netters* are the real cause of the extraordinary absence of birds throughout Italy.

For many years past great complaints have been made against the French and Italians because of the great destruction of wild bird-life in the two countries; many people have protested against it, including "Ouida," who is, I believe, a resident in Italy, and who has on several occasions used her pen in defence of the birds.

My statements about the destruction of swallows in France were based on reports issued by the Agricultural, and the Zoological Society of France, the report of the latter body being subscribed to by three observers who had made special inquiries on the subject, and who wrote:—

"In the springs of 1887 and 1888, hampers were addressed to the naturalists of Paris containing dead swallows in the flesh, not only by hundreds, but by thousands. One lot of these birds, destined for the millinery trade, was spoilt owing to the impossibility of preserving them from putrefaction. These swallows had been captured in the Department of the Bouches-du-Rhône by means of three procedures—the net, by fish-hooks, and by electric wire."

In the report issued by the Agricultural Society of France, in 1894, it was stated on the authority of M. Rosier (delegate of the Society of Agriculture of the Gironde), "that in his district, at the season of their passage, there are killed every year more than a million of the Hirondelles."

The foregoing extracts will, I venture to think, prove that I did not speak without my book when I partly ascribed the decrease of the Hirundinidæ in this country to the massacre of such numbers of the family in France and Italy; and as a further proof that they do not come to our shores so abundantly as formerly, I have received letters from the keepers of some of our lighthouses, who report that during recent years they have remarked a very great falling off in the numbers of these birds at the time of the spring migration, and have wondered as to the cause.

In our own country the main disturbing element is, without a shadow of a doubt, to be found in the action of the house-sparrow, who has constituted itself a most persistent enemy of the swallows, especially the house-martin, whom it harries in every direction, and has been in many instances the cause of whole colonies of martins forsaking their old haunts.

I cannot altogether agree with the theory that the absence of the swallows in their old numbers is due to climatic changes, or to the decrease of their insect food; last summer this part of the country was swarming with winged insect life, so much so that some days the air seemed almost alive, and our rose and fruit trees were smothered with them, but in this town and its immediate neighbourhood swallows and martins were quite scarce, although all the local circumstances are, one would think, favourable for them in every way.

If climatic changes are an affecting influence against the coming of the swallows to this country, why are not other spring migrants affected in the same way? *i.e*, the chiff-chaff (a much earlier immigrant than the swallow), the nightingale, the willow-wren, or the wagtails and many other species, which during the last few years have shown a tendency to increase. I do think, however, that the atmospheric conditions of some of our towns, especially where there are large factories and other sources of noxious vapours, may be the means of keeping the swallows away locally.

My belief then is, that a very large number of the Hirundinidæ are prevented from coming to us by the slaughter which awaits so many of them in the course of their journey from their winter quarters; and that when those who do survive the perils of the way ultimately reach this land, they are interfered with to such an extent by the sparrows that they are not able to multiply so freely as they would do under more favourable conditions, and so their number is kept reduced from year to year.

I am still seeking for trustworthy information from personal observers, and shall be most grateful for any communication that may be sent to me at this address, especially as I propose extending my paper and publishing it in the form of a pamphlet, in which will be included extracts from the letters which have come to me from all over the country.

J. HERBERT ALLCHIN.

Esher, Bower Mount Road, Maidstone, January 7.

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